Aug. 20, 1935. R. W. BROOMHAM 2,011,967

BENDING FIXTURE

Filed July 24, 1933 2 Sheets-Sheet 1

Fig. 1.

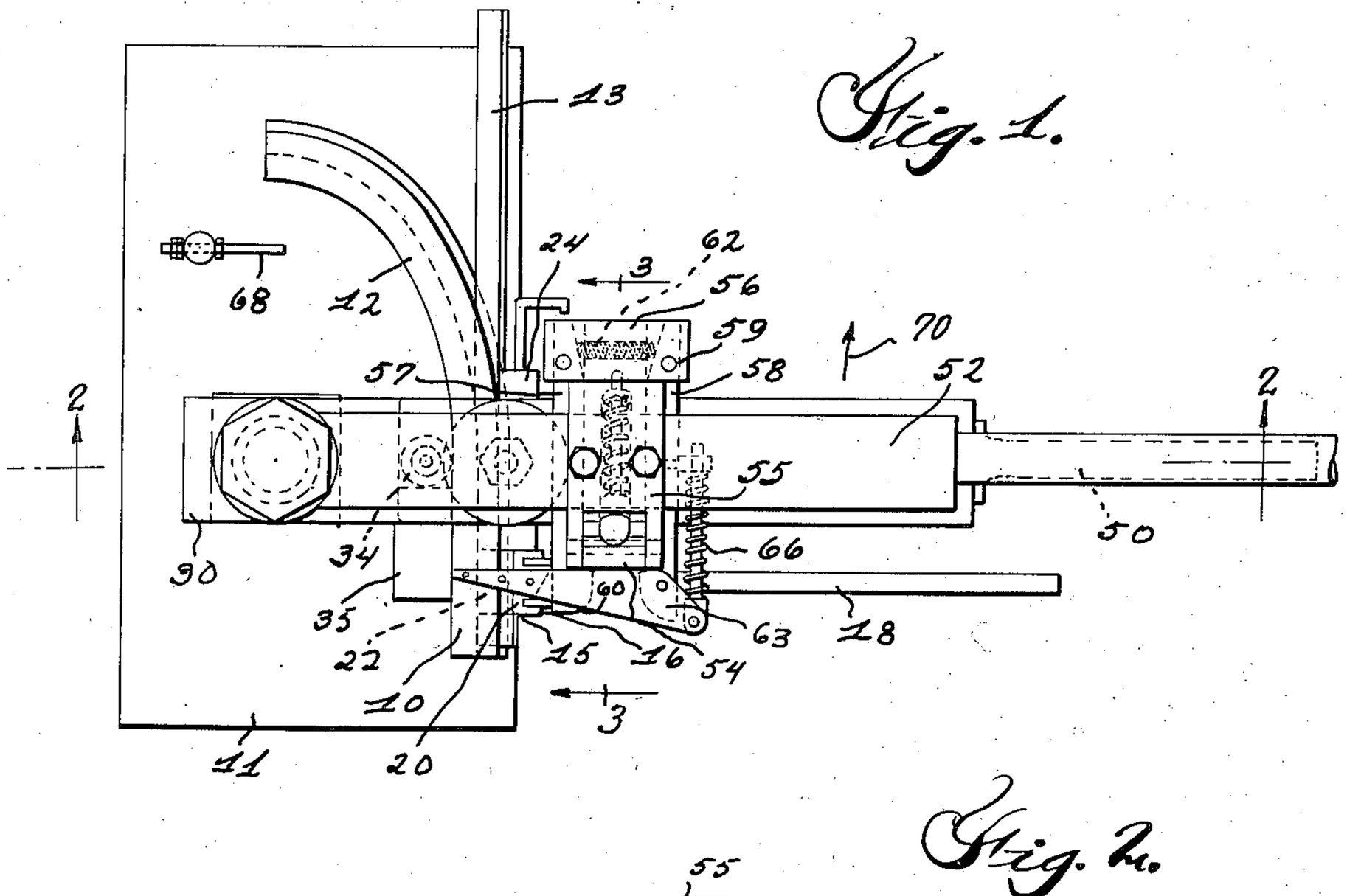

Fig. 2.

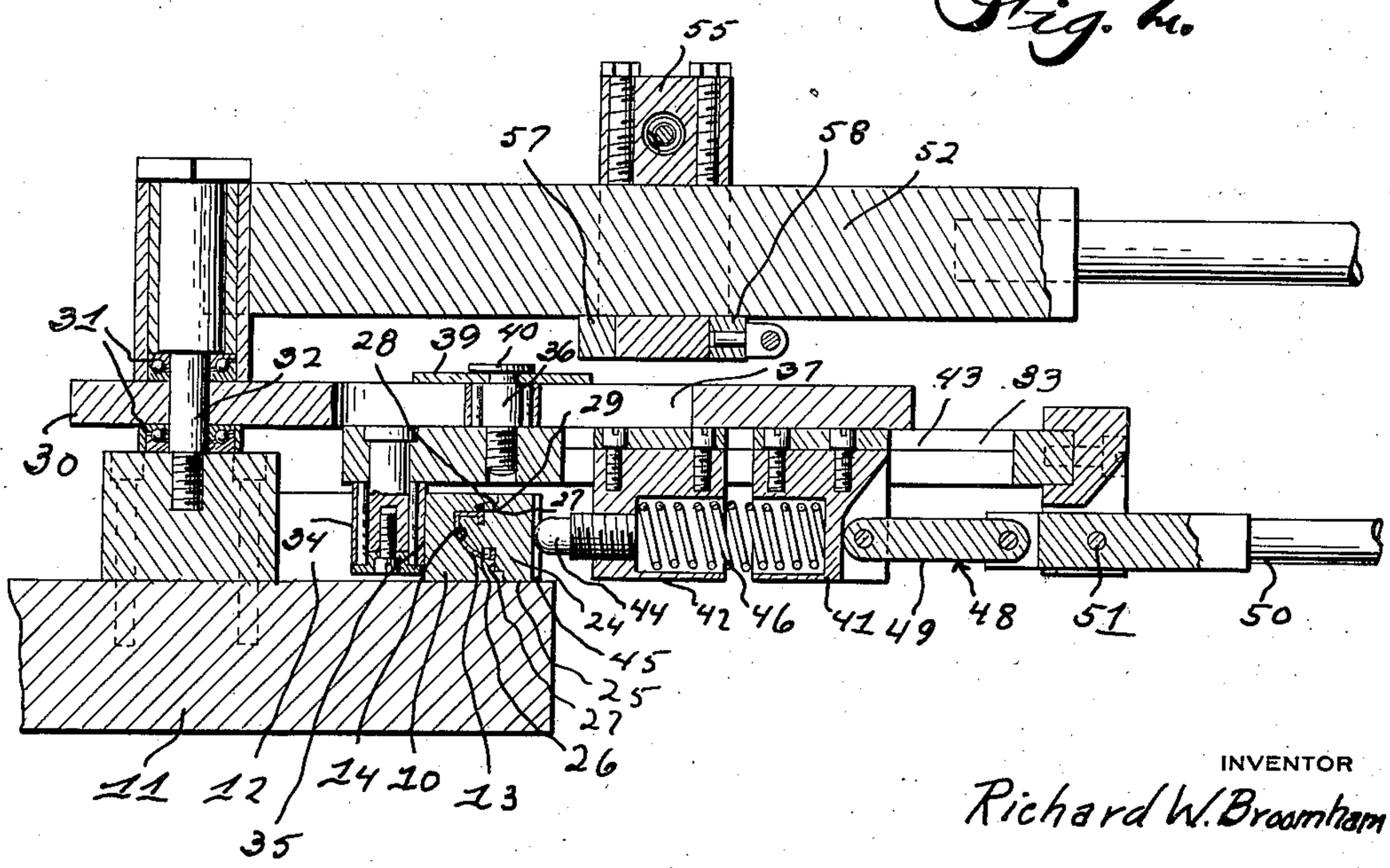

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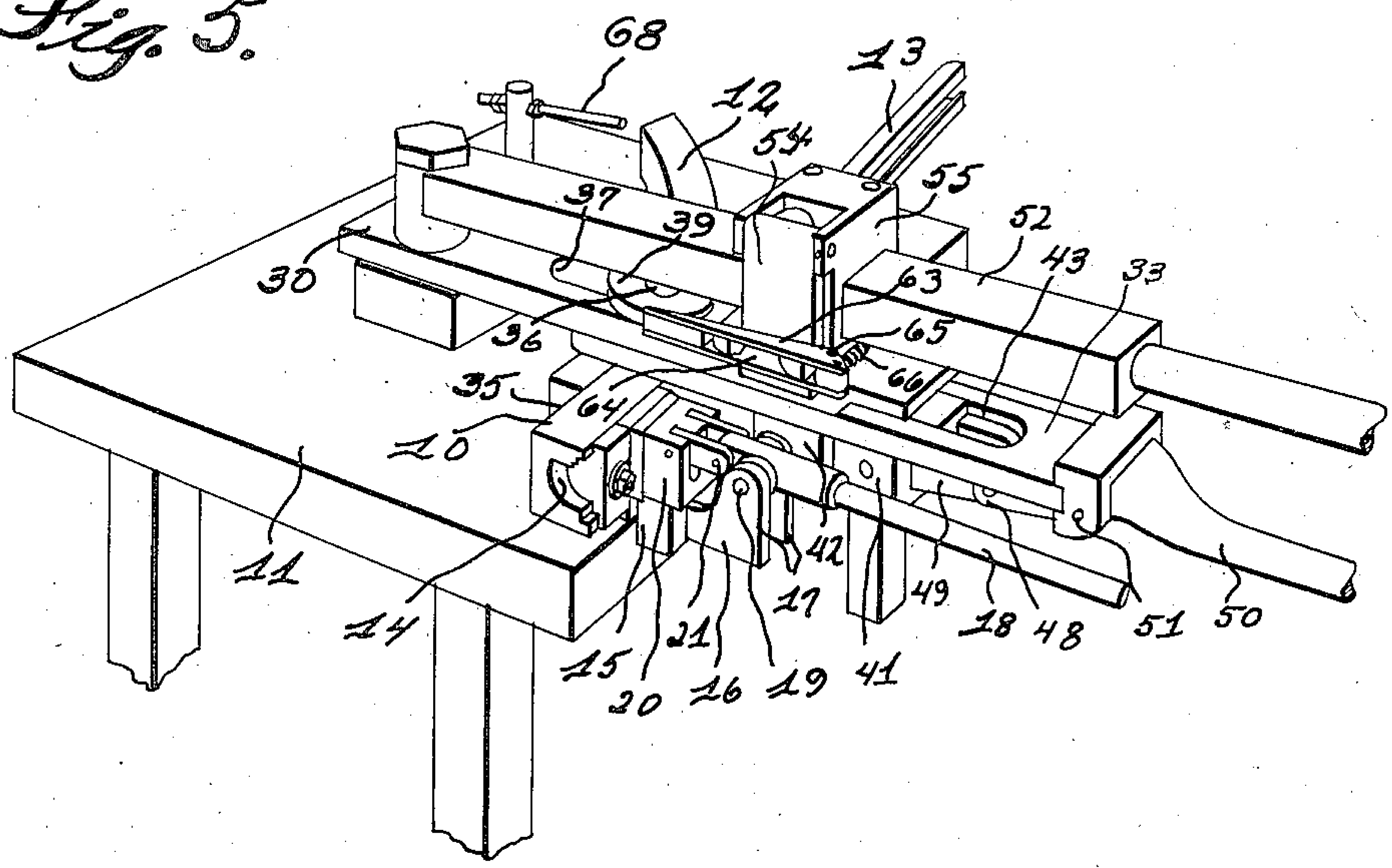
Fig. 5.



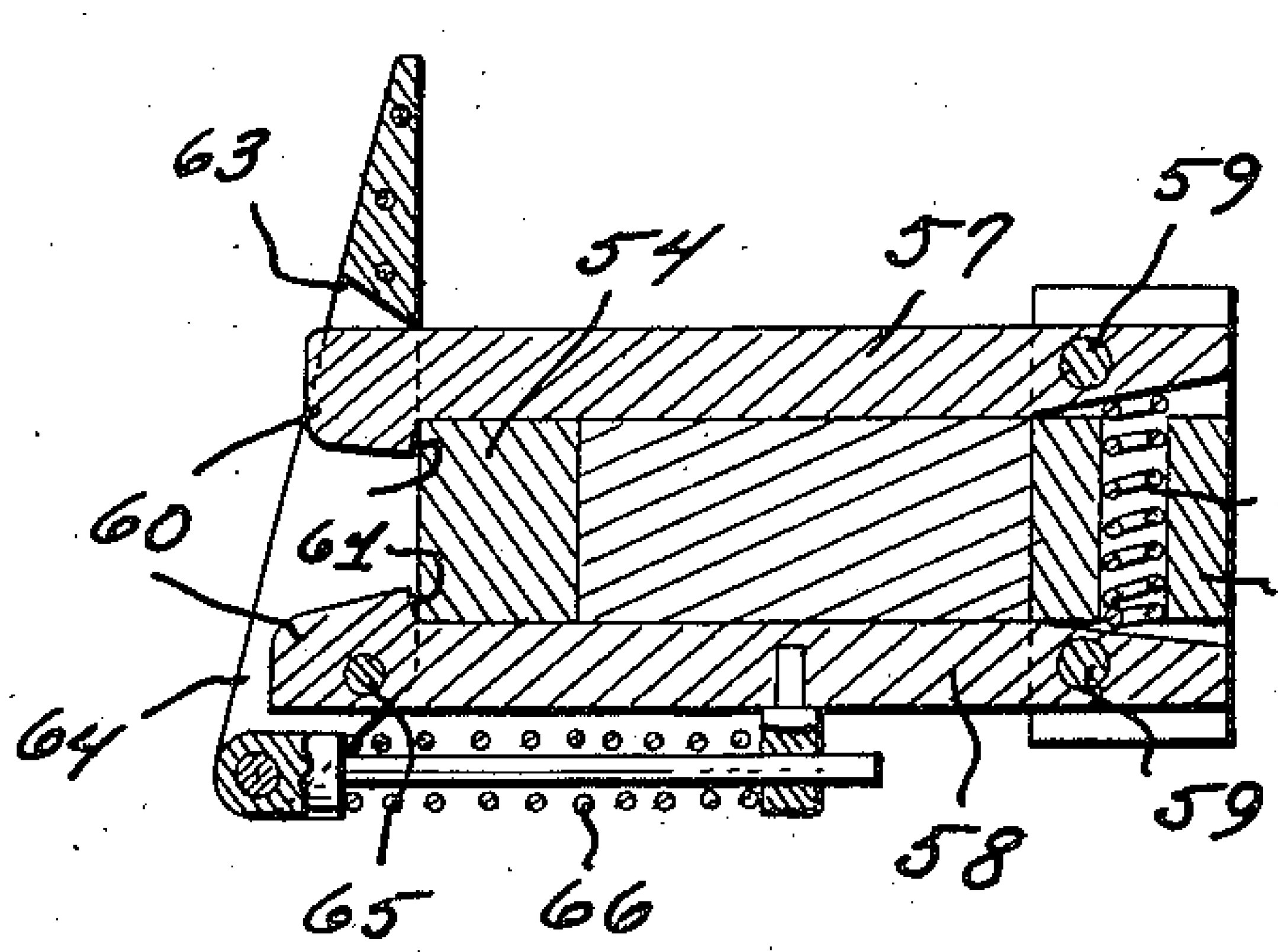


Fig. 4.

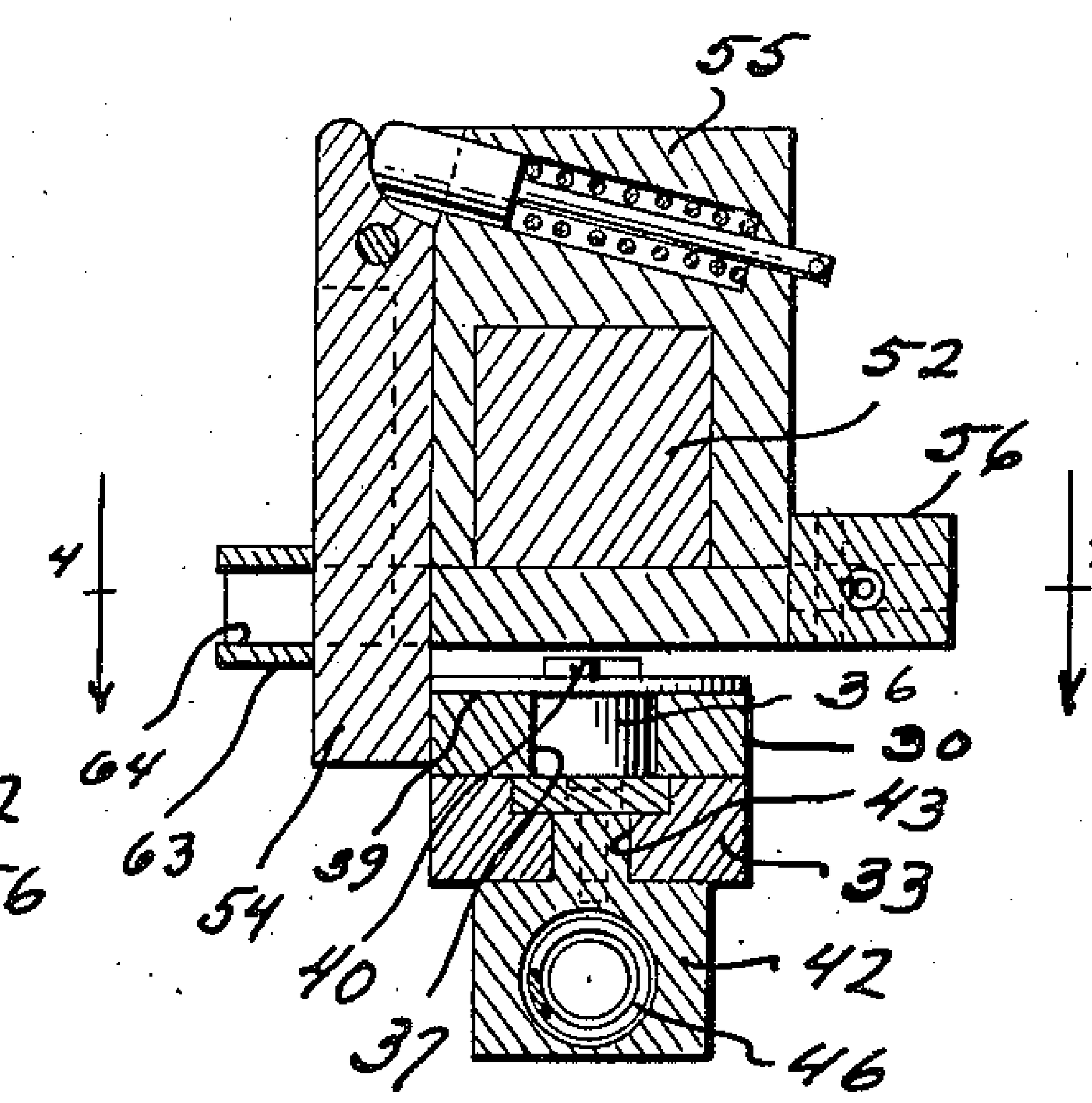


Fig. 3.

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2,011,967

BENDING FIXTURE

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Application July 24, 1933, Serial No. 682,007

14 Claims. (Cl. 153—46)

This invention relates generally to bending fixtures and refers more particularly to devices of this character for bending strip metal to form a curvature therein.

One of the principal objects of this invention is to improve generally bending fixtures of the type set forth by simplifying the construction as well as the operation thereof and by reducing the number of parts of the same to a minimum.

Another advantageous feature of this invention resides in the provision of a bending fixture capable of more accurately bending strip stock to a predetermined contour in a relatively shorter time and with the minimum amount of manual effort or attention.

A further object of this invention resides in the provision of a bending fixture capable of being expediently adapted to bend strip stock to various degrees of curvature by merely interchanging the relatively fixed bending die for one corresponding to the desired contour.

A still further object of the present invention which contributes materially in obtaining the results set forth in the preceding paragraphs resides in the provision of a bending fixture having an actuating member movable throughout a predetermined path of travel relative to the bending die and having means cooperating with the aforesaid die to bend the stock to the contour of the latter including a shoe connected to the actuating member for advancement therewith by means permitting simultaneous displacement of the shoe in a direction transverse to the die as well as in a direction transverse to the latter direction. It necessarily follows from this arrangement that the shoe will be guided throughout its travel by the particular die employed in the assembly, irrespective of the degree of curvature of the latter and irrespective of the fixed path of travel of the actuating member.

Still another feature of this invention resides in the provision of an arrangement of the above type wherein the shoe is yieldably urged into engagement with the die, and wherein displacement of the same relative to the actuating member therefor has no effect on the pressure exerted by the yieldable means. This feature prevents the exertion of undue pressure upon the strip in the die and provides for uniform operation of the fixture at all times.

In addition to the foregoing, the present invention contemplates a connection between the bending fixture and operating means therefor automatically releasable upon completion of the bending operation so as to permit imparting an accurate predetermined curvature to the stock.

The foregoing as well as other objects will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a plan view of a bending fixture constructed in accordance with this invention;

Figure 2 is a sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a sectional view taken on the line 3—3 of Figure 1;

Figure 4 is a sectional view taken on the line 4—4 of Figure 3;

Figure 5 is a perspective view of the bending fixture featuring the clamp for securing the strip of metal in assembled relation with the die.

The bending fixture forming the subject matter of this invention comprises a die 10 fixed upon a suitable platform 11 and having a curved portion 12 corresponding to the curvature it is desired to bend the strip of stock designated in Figure 2 by the reference character 13. As shown particularly in Figure 2, the outer face of the die is formed with a recess 14 therein extending for the full length of the die and having a cross sectional contour identical to the corresponding contour of the strip stock 13. The construction is such as to permit the strip of stock 13 to be telescoped within the groove 14 from the relatively straight end portion of the die, and, in the present instance, the strip is prevented from axial movement relative to the die by means of a clamp 15 comprising a bracket 16 fixed to the outer edge of the platform and having vertically extending ears 17 spaced from each other a sufficient distance to receive therebetween an operating lever 18 pivotally connected intermediate the ends to the ears as at 19. The outer end of the operating lever is positioned for convenient manipulation by the operator, while the inner end of the same is pivotally connected to a jaw section 20 by means of a pin 21. The jaw section 20 is formed with an inwardly extending projection 22 fashioned to extend into the recess 14 of the die and cooperate therewith to secure the strip 13 thereto when the operating handle 18 is in the position thereof shown in Figure 5. It will be apparent from this latter figure that when it is desired to remove the finished strip from the die, the handle 18 is merely rocked downwardly about its fulcrum 19 causing the jaw section 20 to move outwardly or in a direction away from the die 10 a distance sufficient to release the stock therebetween and permit another strip to be inserted in the die. Obvious-

ly, after the strip has been properly positioned in the groove of the die, the handle 18 is merely raised causing the die section 20 to move to a position wherein the strip is clamped between the latter and adjacent wall of the groove.

Cooperating with the die 10 to bend the stock to the contour of the groove in the latter is a shoe 24 slidably supported upon the platform 11 as at 25 and having a projection 26 extending into the groove 14 of the die for engaging the outer surface of the stock 13. As shown particularly in Figure 2, the projection 26 preferably corresponds in cross sectional contour to the corresponding shape of the stock so as to have an extended area of contact therewith and thereby prevent any tendency for the same to wrinkle or otherwise lose its shape upon movement of the shoe relative thereto throughout the length of the die. In this connection, it is to be noted that the shoe is provided with bearing surfaces 27 on opposite sides of the projection 26 for engaging corresponding bearing surfaces on the die, and upward displacement of the shoe relative to the die is prevented by forming a shoulder 28 at the upper end of the die engageable at the underside thereof with a corresponding shoulder 29 on the shoe. The cooperating bearing surfaces 27 on the die and shoe not only guide the shoe throughout its movement relative to the die, but, on the other hand, prevent exertion of undue pressure on the stock during the bending operation.

The mechanism for moving the shoe relative to the die comprises an arm 30 mounted for rocking movement in a substantially horizontal plane and having the inner end journaled between a pair of spaced bearings 31 upon a pin 32 which in turn is fixed to the platform 11. The free end of the arm is operatively connected to the shoe 24, but is not directly connected thereto, since if such were the case, the shoe would be compelled to move around the fixed axis of swinging movement of the arm 30, and this would be objectionable in that it would restrict bending the strips to curvatures having a center coincident with the axis of swinging movement of the arm. In order to provide for bending the strips to any particular degree of curvature irrespective of the location of the axis of swinging movement of the arm 30 relative to the centers of the curvature in the die and at the same time to permit employing the same fixture with dies of different degrees of curvature, I provide the following structure.

In detail, the operative connection between the shoe and arm comprises a member 33 interposed between the arm and shoe 20 as shown particularly in Figure 2. The member 33 is pivotally connected intermediate the ends thereof to the underside of the arm for swinging movement relative thereto in a horizontal plane and is provided at the extreme inner end with a roller 34 engageable with the vertical inner face 35 of the die which is uninterrupted throughout the length thereof so as to accurately guide the member 33 along a path coincident with the longitudinal contour of the die. Inasmuch as certain points on the curvature of the die may be closer to the axis of swinging movement than other points, it is necessary to provide for sliding movement of the member 33 relative to the arm 30 in the direction of length thereof in addition to the aforesaid relative pivotal movement between these parts. Both the sliding and pivotal movements of the member 33 relative to the arm 30 are obtained by a pin 36 having the lower end threaded in the member 33 intermediate the ends thereof and having the upper end projecting through a slot 37 formed in the arm 30. The slot 37 is elongated in the direction of length of the arm so as to provide for the desired sliding movement of the member 33 relative thereto, and the width of the slot is such as to prevent movement of the pin 36 in directions transverse to the slot 37. Disengagement of the pin 36 from the slot is prevented herein by means of a washer 39 fixed to the upper end of the pin as at 40 and having a diameter greater than the width of the slot so as to bridge the same.

From the foregoing construction, it will be observed that the connection between the member 33 and arm 30 is such as to not only permit advancing the member 33 upon rocking movement of the arm 30 about the axis of the pin 32, but to also simultaneously provide for swinging the member 33 relative to the arm about the axis of the pivotal connection 36, and in addition, permits the member 33 to shift radially with respect to the axis of rocking movement of the arm 30. Movement of the member 33 relative to the arm 30 is controlled by the curvature of the die, due to the engagement of the roller 34 with one side of the die and to the engagement of the shoe 24 with the opposite side of the die. The shoe 24 is operatively connected to the arm 33 for movement therewith, or in other words is mounted for displacement relative to the arm 30 in directions toward and away from the axis of swinging movement of the arm 30, and for rocking movement relative to the arm 30 in a horizontal plane parallel to the plane of rocking movement of the member 33. The rocking movement of the shoe provides for displacing the latter in directions transverse to the radial adjustment thereof, and accordingly, it may be said that the shoe is movable in two directions transverse to each other. Also, the two directions just referred to may be said to be transverse to the direction of movement of the arm 30, since the latter is compelled to swing about the fixed axis of the pin 32. In detail, the connection between the shoe 24 and member 33 comprises a pair of blocks 41 and 42 slidably supported by the member 33 in a T-shaped slot 43 formed in the latter member in the direction of length of the same. The block 42 is provided with an inwardly extending abutment 44 normally engaging the outer face of the shoe 24 between vertically spaced shoulders 45 formed on the latter face of the shoe. In this connection, it is to be noted that the point of engagement of the abutment with the shoe and the line of engagement of the roller 34 with the die are substantially in alignment with the projection 26 on the shoe so as to insure efficient engagement of the latter with the strip of metal in the die. In the present instance, the abutment 44 is held in assembled relation with the shoulders 45 on the shoe by means of a spring 46 interposed between the blocks 41 and 42 tending to urge the same in directions away from each other. As will be observed from Figure 2, the spring is placed under tension to yieldably urge the shoe into engagement with the die by moving the outermost block 41 toward the block 42, and this is accomplished herein by means of a toggle 48. The toggle comprises a link 49 pivotally connected at the inner end to the block 41 and at the opposite end to the inner end of a suitable operating handle 50 which in turn is pivotally connected intermediate the ends to the extremity of the member 33 by means of the pin 51. The construction is such

that movement of the operating handle 50 upwardly about its pivotal connection 51 with the member 33 effects an outward movement of the block 41 relative to the block 42, and thereby reduces the tension on the spring to relieve the pressure exerted by the projection 26 of the shoe on the strip. On the other hand, downward movement of the operating handle from the position aforesaid thereof straightens the toggle 48 and tensions the spring 46 so that the latter will exert the desired pressure on the shoe through the action of the block 42. Inasmuch as the aforesaid yieldable means and associated shoe are carried by the member 33, it necessarily follows that any displacement of the member 33 or shoe in the direction of action of this yieldable means will have no effect on the latter or, in other words, will not increase or diminish the pressure exerted by the shoe on the strip of stock.

Although power may be applied directly to the free end of the arm 30 to move the same about its pivotal connection with the support and thereby effect a movement of the shoe throughout the length of the die, nevertheless, I prefer to apply the necessary power to the arm through the medium of a beam 52 and to provide a connection between the beam and arm automatically releasable upon completion of the desired bending operation so as to insure the formation of an accurate curvature in the stock. In detail, the beam 52 is mounted for swinging movement in a horizontal plane above the arm 30, and the free end thereof extends to a position where it may be conveniently grasped by an operator. The beam 52 is connected intermediate the ends to the arm 30 by means of a finger 54 having the upper end pivotally connected for swinging movement about a horizontal axis to a bracket 55 carried by the beam 52. The free end of the finger extends a sufficient distance below the beam 52 so as to engage the front edge of the arm 30 as clearly shown in Figure 5, and is normally held from swinging movement about the aforesaid axis by means of a clamp 56 carried by the bracket 55 below the beam 52. As shown particularly in Figure 4, the clamp 56 comprises a pair of jaws 57 and 58 located upon opposite sides of the lower end of the bracket and having the rear ends pivotally supported from the bracket by means of pins 59. The free ends of the jaws are provided with enlarged portions 60 forming shoulders 61 for engaging the front side of the finger 54 adjacent opposite edges thereof. The shoulders 61 are normally yieldably maintained in engagement with the finger 54 by means of a relatively light spring 62 interposed between the pivoted ends of the jaws beyond the pivots 59 and are positively held in assembled relation with the finger by means of a latch 63 movable over the free ends of the jaws. The latch 63 comprises a lever having a slot 64 therethrough of sufficient dimension to receive the ends of the jaws and is pivotally connected intermediate the ends to the jaw 58 for swinging movement out of engagement with the jaw 57 by means of a pin 65. The latch is normally held in engagement with both jaws by means of a spring 66 having one end anchored to the side of the jaw 58 and having the opposite end connected to the lever beyond the pin 65 as shown in Figure 4. The free end of the latch lever extends laterally beyond the jaw 57 so as to engage a suitable trip 68 mounted upon the bed 11 of the fixture.

Assuming that the several parts of the fixture are in the relative positions thereof shown in Figure 5 wherein the finger 54 is held against pivotal movement relative to the beam by the jaws and that the beam 52 is moved in the direction of the arrow 70 in Figure 1, it will be noted that the arm 30 will be compelled to move with the beam due to the engagement of the finger therewith. During the final movement of the bending fixture relative to the die, the trip 68 releases the jaws from positive engagement with the finger by engaging the free end of the latch lever and swinging the same about the pivot 65 in a direction away from the jaws. After the latch has been released from the jaws, the resistance of the arm 30 and associated mechanism is considerably greater than the spring 62 tending to hold the jaws in engagement with the finger, with the result that the free end of the latter will react upon the shoulders 61 to separate the jaws a sufficient distance to permit the finger to swing beyond the enlarged end portions thereof. This action is accentuated in the present instance by inclining the shoulders 61 in the manner clearly illustrated in Figure 4 so as to provide, in effect, cammed surfaces for engaging opposite edges of the free end of the finger. It will also be apparent that the trip 68 may be adjusted so as to vary the interval of engagement of the same with the latch lever during movement of the fixture throughout its predetermined path of travel. Upon completion of the bending operation, the free end of the finger is swung upwardly out of the plane of the arm 30 and the beam 52 is returned to its initial starting position whereupon the latch 63 is again operated to lock the jaws with the free end of the finger 54 therebetween. The arm 30, as well as the associated parts, is then returned until the front side of the arm engages the rear side of the free end of the finger, whereupon the bending fixture is in a position for the next bending operation.

What I claim as my invention is:

1. A bending fixture having in combination, means for supporting a strip of stock to be bent, means for bending said strip to a predetermined degree of curvature including a shoe engageable with said strip and movable relative thereto in the direction of length thereof, a member having a fixed path of travel in a plane parallel to the plane of movement of said shoe, and a connection between the member and shoe operable to advance the latter relative to the strip and to permit simultaneous movement of the shoe relative to said member in two directions transverse to each other and to the direction of travel thereof by said member.

2. A bending fixture having in combination, means for supporting a strip of stock to be bent, means for bending said strip to a predetermined degree of curvature including a shoe engageable with said strip and movable relative thereto in the direction of length thereof, yieldable means acting upon the shoe for urging the latter in a direction transverse to the direction of movement aforesaid thereof toward the strip, a member having a predetermined path of travel, and a connection between the member and shoe operable to advance the latter relative to the strip and to permit simultaneous displacement of the shoe relative to the member in a direction opposite to the direction of action of the yieldable means without increasing the pressure exerted by the latter on the shoe.

3. A bending fixture having in combination, means for supporting a strip of stock to be bent, means for bending said strip to a predetermined

degree of curvature including a shoe engageable with said strip and movable relative thereto in the direction of length thereof, yieldable means acting upon the shoe for urging the latter in a direction transverse to the direction of movement aforesaid thereof toward the strip, a member having a predetermined path of travel, and a connection between the member and shoe operable to advance the latter relative to the strip and to permit simultaneous displacement of the shoe relative to the member in the direction of action of said yieldable means.

4. A bending fixture having in combination, means for supporting a strip of stock to be bent, means for bending said strip to a predetermined degree of curvature including a shoe engageable with said strip and movable relative thereto in the direction of length thereof, a member mounted for rocking movement about a fixed axis, and a connection between said member and shoe operable to advance the latter relative to the strip and to permit simultaneous displacement of the shoe relative to the member in directions radially with respect to the axis of rocking movement of said member and also in directions transverse to said radial directions.

5. A bending fixture having in combination, means for supporting a strip of stock to be bent, means for bending said strip to a predetermined degree of curvature including a shoe engageable with said strip and movable relative thereto in the direction of length thereof, a member mounted for rocking movement about a fixed axis, yieldable means normally acting upon the shoe for moving the same in a direction toward the strip, and a connection between the member and shoe operable to advance the latter relative to the strip and to permit simultaneous displacement of the shoe relative to the member radially with respect to the axis of rocking movement thereof without affecting the action of said yieldable means.

6. A bending fixture having in combination, a die having a curved portion corresponding to the degree of curvature it is desired to impart to a strip of stock, a shoe movable along the curved portion of the die relative thereto and cooperating therewith to bend a strip of metal to the curvature of the same, yieldable means normally acting upon the shoe for moving the latter in a direction toward the die, a member mounted for rocking movement about a fixed axis, and a connection between said member and shoe operable to move the latter from the former along a path determined by the contour of the die irrespective of the location of said axis relative to the curved section of the die without affecting the action of said yieldable means.

7. A bending fixture having in combination, a die having a curved portion corresponding to the degree of curvature it is desired to impart to a strip of stock, a shoe movable along the curved portion of the die relative thereto and cooperating therewith to bend a strip of metal to the curvature of the same, a member having a fixed path of travel in a plane substantially parallel to the plane of the die, and a driving connection between said member and shoe permitting movement of the latter relative to the former in directions transverse to the general direction of advancement of the shoe by said member.

8. A bending fixture having in combination, a die having a curved portion corresponding to the degree of curvature it is desired to impart to a strip of stock, a shoe movable along the curved portion of the die relative thereto and cooperating therewith to bend a strip of metal to the curvature of the same, a member mounted for rocking movement about a fixed axis, a second member connected to the member aforesaid for pivotal movement relative thereto in a plane parallel to the plane of movement thereof and also for sliding movement radially of the axis of rocking movement of the same, and means operatively connecting said shoe to the second member.

9. A bending fixture having in combination, a die having a curved portion corresponding to the degree of curvature it is desired to impart to a strip of stock, a shoe movable along the curved portion of the die relative thereto and cooperating therewith to bend a strip of metal to the curvature of the same, a member mounted for rocking movement about a fixed axis, a second member connected to the member aforesaid for pivotal movement relative thereto in a plane parallel to the plane of movement thereof and also for sliding movement radially of the axis of rocking movement of the same, means operatively connecting said shoe to the second member at one side of the pivotal connection of the latter with the first member, and means carried by the second member at the opposite side of the aforesaid pivotal connection for engaging the side of the die opposite the side thereof with which the shoe engages to compel movement of the second member throughout a path corresponding to the curvature of the die.

10. A bending fixture having in combination, a die having a curved portion corresponding to the degree of curvature it is desired to impart to a strip of stock, a shoe movable along the curved portion of the die relative thereto and cooperating therewith to bend a strip of metal to the curvature of the same, a member mounted for rocking movement about a fixed axis, a second member connected to the member aforesaid for pivotal movement relative thereto in a plane parallel to the plane of movement thereof and also for sliding movement radially of the axis of rocking movement of the same, means operatively connecting said shoe to the second member, and means compelling movement of the second member along a path corresponding to the curvature of the die irrespective of the location of the axis of rocking movement of the first member relative to the curved portion of the die.

11. A bending fixture having in combination, a die having a curved portion corresponding to the degree of curvature it is desired to impart to a strip of stock, a shoe movable along the curved portion of the die relative thereto and cooperating therewith to bend a strip of metal to the curvature of the same, means for moving the shoe relative to the die in the direction of length of the latter including a member mounted for movement throughout a predetermined path of travel, a second member operatively connected to the member aforesaid for actuating the same, and means for releasing the connection between said members at a predetermined point in the path of travel of the first named member.

12. A bending fixture having in combination, a die having a curved portion corresponding to the degree of curvature it is desired to impart to a strip of stock, a shoe movable along the curved portion of the die relative thereto and cooperating therewith to bend a strip of metal to the curvature of the same, a member mount-

ed for rocking movement about a fixed axis, a second member connected to the member aforesaid for pivotal movement relative thereto in a plane parallel to the plane of movement thereof and also for sliding movement radially of the axis of rocking movement of the same, means operatively connecting said shoe to the second member including yieldable means normally arranged under tension between the shoe and a part carried by said second member, and means for releasing the tension of the yieldable means to release the pressure exerted on the strip by the shoe.

13. A bending fixture having in combination, a die having a curved portion corresponding to the degree of curvature it is desired to impart to a strip of stock, a member movable along the curved portion of the die relative thereto and cooperating therewith to bend the strip of material to the curvature of the die, an element mounted for rocking movement about a fixed axis, a second element connected to the element aforesaid for sliding movement relative thereto radially with respect to the axis of rocking movement, means compelling movement of the second element along a path corresponding to the curvature of the die, and means operatively connecting said member to the second named element including a spring carried by the second named element and acting upon the member tending to urge the latter in a direction toward the die.

14. A bending fixture having in combination, a die having a curved surface at one side corresponding to the degree of curvature it is desired to impart to a strip of stock and having a cam face at the opposite side corresponding to the curved surface aforesaid, a member movable along the curved surface of the die relative thereto and cooperating therewith to bend a strip of material to the curvature of the same, an element movable throughout a fixed path of travel, a second element operatively connected to the member aforesaid, a connection between the second element and first named element compelling movement of the former as a unit with the latter and providing for displacement of the second element relative to the first element in directions transverse to the path of travel of said member and a cam follower upon said second named element in engagement with the cam face of said die.

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